CHASSIS LUBRICATION
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What Greases for Hot Motors?

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A problem that isn't solved by guessing

Greases that will give good satisfaction when used in motors operating within the normal temperature range of 32 to 175 deg. F. are quite plentiful. They may not be ideal from all standpoints, but they will lubricate without undue trouble. Step outside of this range and you run into a host of difficulties.

Let us first consider continuous operation at temperatures of around 200 deg. F. Use of calcium, aluminum, and zinc soaps in making these greases is of course prohibited, since the safe operating temperature for greases with these bases is about 150 deg. F. Above this temperature the water used to combine the soap and oil is slowly driven off, causing breakdown of the grease and separation of free oil and soap. Therefore, only sodium- or sodium-calcium-soap combinations can be considered in the greases now available.

To a certain extent the flow point of a grease is a measure of the temperature it will stand in a motor, but this relationship does not always hold true. It is a quick means of distinguishing between a sodium- and a calcium-base grease, because the flow point of the calcium grease will seldom be above 210 deg. F. Sodium- or sodium-calcium-base greases may have flow points varying from 250 to 410 deg. F. in a consistency range suitable for use in motors, depending on the consistency and method of manufacture.

Two general types of greases are offered for high-temperature service. The kind most in favor for ordinary applications where resistance to heat is the primary object and starting and running torques are secondary, is composed of a heavy-viscosity oil of the steam cylinder type combined with a sodium soap. Such greases are mostly dark green or black in color. The heavy viscosity of the oil is noticeable when some of the grease is placed in the palm of the hand and worked with a finger. For slow-speed bearings and temperatures up to 275 deg. F., they are usually best.

When Temperatures Drop

If the temperature ever drops much below 32 deg. F., however, they are likely to give serious trouble. When the grease breaks down because of heat or oxidation, the bearing is gummed up much worse than it would be with a grease containing a lighter-viscosity oil. The heavier, darker-colored petroleum fractions usually are more easily oxidized than the lighter fractions.

The other type of grease uses an oil of lighter viscosity, in some instances as low as 280 to 300 seconds at 100 deg. F. Color may vary from almost pure white to amber and darker shades. To obtain the same consistency in these greases, the soap content must be much higher than in the type previously mentioned, ranging from 15 to more than 30 per cent in the grades that can be used for motor lubrication.

Both sodium and sodium-calcium soaps have been used, the straight sodium grease giving the highest flow points. It has never been proved, however, that a sodium-base grease can operate continuously at any higher temperatures than the mixed-soap-base type. The process of manufacture of the grease and the percentage of caustic soda used to the fats and fatty acids present in making the sodium soap influence the flow point and stability of these greases.

Although very stiff greases have been made for use in locomotive driving journals operating at high temperatures, these products are not suitable for motor lubrication of the type under consideration.

It has been said that as the temperature rises above 200 deg. F. the rate of oxidation of an oil or grease is doubled for every rise of about 15 deg. F. Indications are that oxidation is slow up to about 220 deg. F. and increases rapidly above that point. Certainly a grease can be no better than its constituents, so far as resistance to temperature is concerned. If the oil used in a grease will darken and oxidize at the temperature it is subjected to, the grease will not be satisfactory.

Assume that grease is desired for use where the bearing temperature may reach 300 deg. F. How can it be selected without actual trial in a motor, possibly at the risk of spoiling some bearings?

The first and simplest test is to put some of the grease in a clean porcelain crucible and place it in an oven at a temperature of 300 deg. F. If the oven is not air tight and there is some circulation, oxidation will proceed more rapidly. Most greases will blacken and turn acid in less than one day's exposure to this temperature.

Courtesy Factory Management and Maintenance.

For the next test pack the grease in all-steel bearings, place them on watch glasses, put in the oven, and note the length of time required for darkening. Besides the appearance of the grease, increase in stiffness is noted, using test apparatus designed for that purpose and described in the *General Electric Review*, May, 1937. In addition, increase in acidity in the grease in the bearing over varying periods of time can be determined.

Try It On Bronze

Now the grease should be subjected to the same tests in a bearing using a bronze retainer. Greases which will successfully stand 300 deg. F. in an all-steel bearing will go to pieces in two days' time in the presence of bronze. It can safely be said that no grease is available on the market which will remain stable under these drastic conditions. If one were found, however, the next step would be to put it in a bronze and steel bearing operating in a motor, which imposes still more severe conditions since the oxidation of grease has a tendency to increase under agitation and with occlusion of air by the grease.

What elements in the grease are least stable at high temperatures? Is the oil or the soap responsible for the breakdown which occurs? What can be done to overcome these drawbacks? In an attempt to answer these questions some of the most stable oils available on the market, including colorless refrigerator oils, were placed in porcelain crucibles in an oven at 300 deg. F. The best of these oils lasted two or three days before turning black, while the refrigerator oil took nearly a week to darken to a dark brown color.

Unless there are still better oils available, it would seem that the oil used in the grease needs some addition to stabilize it against heat.

I believe that there are at least two separate reactions which take place in a lubricating grease when it is subjected to a temperature in excess of, say, 220 deg. F. There may be a darkening of color due to chemical changes, or the formation of dark chemical compounds, without noticeable increase in acidity. This may, however, be the initial stage of oxidation, before the product has reached the point at which organic acids are formed. Darkening of color can be prevented or at least retarded considerably by the use of certain anti-oxidants.

In the other case there may be free organic acids formed without noticeable change of color. This reaction may also be retarded by suitable additions, which will not, however, stop the darkening that may take place later. The solution may be an ideal anti-oxidant which prevents both reactions, or else a combination of two anti-oxidants which will not react chemically with each other when added to a grease.

Although soap alone may darken or even burn black at a temperature of 300 deg. F., when it is mixed with oil there is less tendency for this action to take place. In many instances it has been found that in greases which have turned black, the soap left behind is white in color after the oil has been dissolved out, although this is not always true. I believe, however, that if the oil used were ideal from the standpoint of stability in the presence of heat, a solution of the problem would be considerably closer.

Metals with which the grease comes in contact play a highly important part in contributing to its chemical instability, especially where higher temperatures are concerned. The presence of dissimilar metals is not needed to produce this effect; therefore electrolytic action cannot be considered seriously unless the impurities within the metal itself are considered as focal points for causing electromotive reactions.

The change in the grease seems to be an oxidation phenomenon because when darkening takes place, this darkening starts at the outer exposed surfaces and progresses inward. A large mass of grease may have its exterior surface blackened and be acid in reaction while the center of the mass will be unchanged. If the components from which the grease was made would not stand the temperture involved, the grease would be blackened all the way through.

Not Too Thin, When Hot

When a grease has been found which will not darken and oxidize when simply in contact with metals which may be used in bearings, the next step involves similar tests after the grease has been thoroughly worked in a bearing. Usually after a grease has been agitated and has whipped up air, the tendency to oxidize is greatly enhanced.

Another point to watch very closely is the loss of consistency at higher temperatures. At a temperature above 220 deg. F. most greases have a tendency to become very thin. As a result they are not heavy enough to remain in the bearing, but will leak out along the shaft and get splashed on the windings. This action of grease at high temperatures can be observed to some advantage in the B.E.C. grease testing machine. When a bearing in use in this machine is shielded on the lower side, and the grease leaks through this shield noticeably at some temperature, it is an indication that the grease cannot satisfactorily be used in a motor at that temperature.

The running-torque readings on the B.E.C. machine give a rough indication of when the danger point on thinning relative to grease retention is reached. Experience has shown that if the running torque at any temperature never goes below 180 gram-centimeters, the chance of grease leakage is small. There are always exceptions to the rule, however, in that some thin greases have been found which stay in place better in sealed bearings than do others of heavier consistency. An effect of capillary action may be involved.

An indication of this effect may be obtained by polishing some strips of stainless steel about 6 in. long by 1 in. wide, marking a line across them 2 in. from one end and smearing a standard weight of grease to a thickness of $\frac{1}{16}$ in. over the 2-in. area. The strips are then allowed to remain at normal temperature and observed every few days for the extent of oil creepage along the polished surface. The oil from some greases will creep five or six times as fast as that from others.

Instead of a grease thinning out under high temperatures, the opposite effect may be noticeable not only in bearings on preliminary test in ovens but also in motors under operating conditions. That is, there may be a change in the physical structure which causes hardening with age, independent of the stiffening due to oxidation of the grease. This action is especially characteristic of sodium- and sodium-calcium-base greases. When the grease is first put in a motor it operates satisfactorily, but as time goes on it stiffens. If the bearing cap is removed and the grease examined, it appears to be in perfect condition in the cap, whereas in reality it has hardened sufficiently so that none is being fed into the bearing, which eventually fails from lack of lubrication. This condition is especially undesirable with roller bearings, which require a grease thin enough to get in around the ends of the rollers at all times or excessive wear will result.

Watch the Fibers

There is also some temperature beyond which these sodium- and sodium-calcium-base greases cannot be heated under rotation without fiber growth taking place. Most sodium-base greases when manufactured have a structure composed of long fibers and are commonly referred to as fiber greases. Because a smooth, butter-like consistency is desired by most users, this fibrous structure is broken up and the fibers shortened by milling the grease. Such treatment gives the smooth appearance desired at nor-

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The INSTITUTE SPOKESMAN

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Institute Placement Service Established

Pursuant to the instructions of the Board of Directors the Institute Spokesman will act as a clearing house for men looking for positions and members looking for qualified men.

A "Placement" service has been undertaken by the National Lubricating Grease Institute and any organization looking for qualified men, or any men looking for positions can obtain assistance by addressing their inquiries to the Editor of this publication. All inquiries will be held strictly confidential and immediately forwarded to the Chairman of this service who will personally handle all applications and inquiries direct.

We urge you to make use of this service which should prove of great value to both prospective employer and employee.

Additional Copies of October issue listing N.L.G.I. Classification still available

*What Car Makers Say**

LATEST FACTORY RECOMMENDATIONS

BUICK PARKING BRAKE CABLES

The manufacturer's recommendations for Parking Brake Cables on 1940 Buick car reads: "If lubrication is required, refer to car dealer."

Because of difficulties experienced in the field with parking brake cable lubrication, Buick has made this recommendation retroactive for all models with hydraulic brakes.

Considerable difficulty in this connection has been due to damages of the gasket between the cable conduit and the brake backing plate. A new gasket should always be used whenever the cable is removed.

Furthermore, when sliding the conduit on the cable to lubricate, the cable often becomes unhooked from the lever inside the backing plate, which necessitates the use of a special tool to hook the cable on the lever; otherwise the backing plate will have to be removed.

Because of these difficulties, the factory prefers that parking brake cables on Buick models be referred to the car dealer for service whenever lubrication is required.

NASH WATER PUMP LUBRICATION

It was originally intended that the water pumps of 1940 Nash cars would require no lubrication and original instruction books issued by the factory indicated this. All Nash models for 1940 have a tapped hole in the water pump in which was installed a pipe plug.

The Nash factory has now decided that this point should be lubricated every 3,000 miles with water pump lubricant through a fitting. The factory is immediately installing fittings on all cars, and cars that went out previous to this change should have the pipe plug removed and a fitting installed. If any Nash cars come into your station with the plug still in place, this plug should be removed with a fitting, or the car owner should be notified to request the Nash dealer to do this in order to conform to latest factory recommendations.

COLLIER'S PREVENTIVE SERVICE CAMPAIGN

COLLIER'S is sponsoring a great campaign to acquaint car owners with the necessity, safety and economy of preventive service to their cars. This campaign will consist of a series of messages to car owners which will appear in COLLIER'S Magazine, messages on such subjects as "How to Get Your Car Ready for Winter" (Nov. 4 issue)—"How to Stop and Start Your Car in Winter" (Dec. 9 issue)—"This Thing Called Safety" — "Motor Reconditioning, what it is and how it should be done"—"The Spring Tune-up for Motor Cars"—"Summer Touring Information" and others of equal seasonal importance.

COLLIER'S is purchasing space in leading trade magazines to tell the industry of this Preventive Service movement. Approximately 30 COLLIER'S merchandising men are available for meetings of jobbers and dealers to present them with specific information as to how they can tie in to secure maximum benefit from the campaign.

It is obvious that COLLIER'S Preventive Service program offers jobbers, manufacturers and dealers a truly great opportunity for increasing the sale of their own products and services. Properly informed, consumers will buy more automotive merchandise and services. WHAT they will buy will depend upon the activity of the individual manufacturers and jobbers. WHERE they will buy depends upon individual dealer activity.

COLLIER'S has made available aids that will help you to tie in with the program, including mounted reprints, folders for mailing pieces, window streamers and counter displays. For further information as to how you may reap the benefits of this great movement, write COLLIER'S Preventive Service, 250 Park Avenue, New York City.

FORD AND MERCURY REAR WHEEL BEARING LUBRICATION

The Ford factory recommends that the rear wheels on all 1940 Ford and Mercury cars be removed for lubrication of the bearings, although some cars have been released with fittings at these points. These fittings should not be used for lubrication of the rear wheel bearings, as it is the desire of the manufacturer that on all 1940 models the wheels be removed and the bearings cleaned and repacked with Wheel Bearing Grease every 5,000 miles.

This recommendation has been made retroactive to include all Forl and Mercury models with hydraulic brakes and will, therefore, affect 1939 as well as 1940 models.

Dealers have been instructed to remove the fittings from rear wheels on 1939 and 1940 Ford and Mercury models, where found, and replace them with plugs.

NASH—ALL MODELS ALL YEARS—Nash now recommends that starters and generators on all models for all years be lubricated every 5,000 miles.

OLDSMOBILE—ALL MODELS ALL YEARS—Oldsmobile recommends a 5,000 mile interval for front wheel bearing lubrication

on 1940 models. This 5,000 mile recommendation has been made retroactive for all models, all years.

Studebaker—All Models All Years—Studebaker has changed the crankcase recommendation for temperatures over 90 deg. from SAE 30 to SAE 40.

Ford Spring Lubrication

The Ford Motor Company has asked us to again emphasize the importance of using special spring lubricant made to Ford specifications for the lubrication of all Ford, Mercury and Lincoln Zephyr springs that have fittings at the spring tie bolt. Ford states that the use of chassis lubricant results in the oil working out of the lubricant, leaving the soap base which fills up the grooves in the springs. When these grooves become clogged up, no more lubricant can be forced through and hard riding results.

*New Grease Seals: Service to the Customer, A Profit for You**

By L. P. Denny, *Vice-President*
National Motor Bearing Co., Inc., Oakland, Calif.

Service Stations, large and small, are responding to "Balanced Selling" ideas. There must be an incentive, and no great amount of excavation is necessary to find it. When a customer drives in for gas, why not sell him tires — might as well have the car greased — the front wheel bearings repacked, or probably a brake relining job is there for the asking.

To carry this one step further, some stations are collecting additional revenue by installing new oil or grease seals with each brake relining job. The most successful station we know guarantees its brake relining jobs. No job is started unless the customer will consent to use new oil and grease seals. This is good, cheap insurance for the customer and a source of easy extra profit for the service station. It costs the service station little in labor and at the same time there is profit in the sale.

The same logic applies to front wheel bearing repacking jobs. New seals insure a better job. Again — extra profits for the service station and good cheap insurance for the customer — shall we say, a "repeat" customer!

In addition to the profit incentive, there are other good reasons why the service station should insist on the customer's installing new seals. Most of these reasons are applicable to brake relining jobs; however, these are presented specifically for front wheel bearing repacking jobs. These bearings are usually repacked each 5,000 miles and new seals should be installed because:

1. Wear on the sealing member may be sufficient to cause leakage before the next greasing.
2. No one can be sure of the mileage on a grease seal.
3. When removing seals they are usually damaged regardless of wear.
4. How can an attendant be sure that the seal was not abused when it was previously removed and reinstalled?
5. Average sized seals are .004 in. larger than the housing bore. When the seal is installed there is a certain amount of distortion. It is impossible to reinstall a seal in exactly the same position which it occupied before removal.
6. When removing a seal, there is great danger that the case will be sprung to a point where the sealing lip will foul the case or the case opened up enough to permit leakage. Most cases are .05 in. thick; some are .03 in., and a few are heavier.
7. Used seals, unless they have been specially treated, are much harder to reinstall without injuring the sealing lip or without turning part or all of the sealing lip back.
8. It is almost impossible to clean a seal. If cleaning solutions are used, this to a certain extent injures the sealing member.

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mal temperatures, but if the grease is heated and churned at a certain temperature, which will vary with the percentage of soap present and the method of manufacture, the undesirable, long-fibered structure may return. These long fibers roll into balls and prevent successful lubrication; hence this is another feature to watch out for.

If all the conditions mentioned are met, the grease is then ready to be tried out in a motor equipped with bearings having bronze retainers and running at the desired temperature. After passing this final test the grease is considered to be satisfactory.

To be entirely satisfactory for operation at 300 deg. F. a grease should possess the following characteristics: (1) It must not oxidize and turn acid, burn, or get sticky. (2) There must be no separation of oil and soap, and it must not dry out. (3) The grease should not become stiff or hard in the presence of any metals with which it may come in contact in a bearing. (4) It should be of smooth, buttery consistency and remain that way in the presence of heat, without becoming fibrous. (5) Since darkening of colors is tied up intimately with the first stages of oxidation, the grease should not darken at the temperature at which it is to be used.

The heavy, steam cylinder oil type of grease may prove most satisfactory if running torque and ability to lubricate at a low temperature are not factors.

At present the number of greases which will pass the majority of these tests is very few. None that I know of will pass all of them, but progress is being made. Grease manufacturers have done intensive work during the past two years to develop better products, and as a result the standards of lubricating greases are much higher than they used to be. There is still some feeling that to say a grease must stand 300 deg. F. is asking the impossible. This requirement can be met successfully at the present time if the grease does not come in contact with certain metals which act as catalysts to promote oxidation. Possibly the time is not far distant when this last obstacle will be overcome, and the ideal grease will be available.